ADDENDUM TO VERIFICATION OF TREATMENT REPORT

Area 2 Phase I
Firing Range Stabilization Project

Prepared For:

Fluor Daniel Fernald
Cincinnati, Ohio

Prepared By:

Sevenson Environmental Services, Inc.
Midwest Division

August 1999

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1.0 INTRODUCTION

Sevenson Environmental Services, Inc. (Sevenson) presents this Addendum to the Verification of Treatment Report (VTR) for the Area 2 Phase I Firing Range Stabilization project at the Fernald Environmental Management Project (FEMP) site in Fernald, Ohio. This report has been prepared in accordance with the requirements of Section 02211 of the technical specifications.

Sevenson was subcontracted to stabilize approximately 45 cubic yards of above-RCRA lead-impacted soils at the Firing Range site. Sevenson used its patented MAECTITE® process to stabilize the soils in-situ.

As part of its scope of work, Sevenson collected and analyzed stabilized soil samples to verify that the treatment objectives have been achieved. The treated soils were to meet or exceed the requirements of the Toxicity Characteristic Leaching Procedure (TCLP) test for lead (maximum concentration of 5.0 mg/l).

This Addendum to the VTR presents a summary of the results of the sampling and analysis program for treated soils at the Firing Range site. The sampling and analysis program was designed to provide statistically defensible data, confirming all of the site soils have been stabilized in accordance with the project requirements. In addition, a summary of the stabilization methods will be presented.

1.1 Area Description

The Area 2 Phase I Firing Range site is located in the southern quadrant of the FEMP in the Southern Waste Units. FEMP security employees used the range for training purposes from the mid-1950's until 1988. This activity resulted in the surface deposition of lead fragments into the side of a hill.

Site characterization studies identified the presence of lead-impacted soils above the RCRA standard of 5.0 mg/l at the Firing Range site. Pre-design investigation was performed by Fluor Daniel Fernald (FDF) to delineate the limits of the area to be stabilized.

1.2 Stabilization Methods

The areas and depths of soil stabilization was as shown on the Construction Drawings, specifically Drawing No. 92X-5900-G-01031. The soils from the three treatment areas (Areas A, B, and C) were excavated and pulled toward the excavator to the nearest level area at the bottom of the hillside, then stabilized. In addition to the three main treatment areas, a smaller fourth area was excavated, spread out at the bottom of the hillside with the soils from Area A, and treated.

Surveying to confirm the limits of stabilization was performed by FDF. Results of the post-excavation survey, as well as results of FDF split samples, will be included in the transmittal letter of this document to the agencies.

MAECTITE® liquid reagent was sprayed onto the ground surface and mixed into the soils with a flat-edged backhoe bucket. The mixing may be described as a back-and-forth folding motion, which created a homogeneous mix. Water was added as a carrier medium to enhance the dispersion of the reagent, followed by additional mixing.

2.0 SOIL SAMPLING AND ANALYSIS

The primary objective of the soil sampling and analysis program was to collect samples that were representative of the soils treated with the mixing and stabilization process. Further, the program was to provide a 95% confidence level that more than 99% of the treated soil is below the TCLP criteria limits.

The soils treated by Sevenson's MAECTITE® process were sampled and analyzed for treatment verification after pH readings below 6 were documented to verify proper application and mixing (Table 1).

Table 1
Process Control Data
Area 2 Phase I Firing Range

Area	Treatment Date	Post-Treatment pH Values	Reagent Quantity (Gallons)
A	7-13-99	5.44, 5.46, 5.36, 5.69, 5.55	250
B	7-13-99	5.94, 5.82, 5.80, 5.95, 5.75	110
C	7-13-99	5.92, 5.96, 5.33, 5.87, 5.43	15

The following sections present the treated soil sampling, analytical results, and an *a posteriori* sample size test to confirm that the sample size was sufficient to assess compliance with the TCLP limit.

2.1 Treated Soil Sampling

Sevenson identified sample locations in the field for verification of treatment sampling and analysis. This strategy was based on the assumption that each area, after treatment, was uniform and homogeneous with respect to leachable lead.

The treatment areas were designated as Areas A, B, and C, per Drawing 1 in the Addendum to the Verification of Treatment Sampling Plan. The sampling program involved collecting a total of eight samples and one duplicate sample from the surface (0 to 0.5 feet) of the three treatment areas. Four samples were taken from Area A, three samples were taken from Area B, and one sample was obtained from Area C. A second sample taken in Area C is a duplicate of FR-C-1. The samples were numbered sequentially, beginning with FR-A-1 (Firing Range - Treatment Area A, Sample Number 1).

Sevenson collected approximately 350 grams of treated soil for each sample. The samples were homogenized in the field, using a disposable plastic spoon and lined mixing basin, prior to being labeled, packaged, cooled to 4°C, and shipped to an offsite laboratory for analysis after holding for 7 days.

The sample homogenization technique was as follows:

1. Divide sample into quarters and thoroughly mix each quarter.
2. Combine two opposite quarters into halves and thoroughly mix each half.
3. Combine halves into one and thoroughly mix.
4. Return to Step 1 until sample has been mixed twice.
5. Place sample into applicable sample container for shipment to lab.

One hundred percent (100%) of the samples were split with the FDF Construction Manager and analyzed at FDF's on-site laboratory. Ohio EPA was also involved during the sampling activities and split two samples to be analyzed at their laboratory.

2.2 Analytical Results

The verification samples were shipped to General Engineering Laboratory (GEL) in Charleston, South Carolina for offsite analysis by U.S. EPA SW-846 Method 6000/7000 for TCLP Lead. The analytical results for the Firing Range samples are presented in Table 2.

Table 2 Verification of Treatment Analytical Results – 2463 Area 2 Phase I Firing Range			
Sample Date	**Sample Number**	**FDF Facts ID**	**TCLP Lead (mg/l)**
7-13-99	FR-A-1	200357348	ND < 0.05
7-13-99	FR-A-2	200357352	ND < 0.05
7-13-99	FR-A-3	200357353	0.358
7-13-99	FR-A-4	200357354	ND < 0.05
7-13-99	FR-B-1	200357355	ND < 0.05
7-13-99	FR-B-2	200357356	ND < 0.05
7-13-99	FR-B-3	200357357	0.394
7-13-99	FR-C-1	200357358	ND < 0.05
7-13-99	FR-C-2 (Duplicate)	200357359	ND < 0.05

2.3 a posteriori Sample Size Test

Eight samples (plus one duplicate sample) were collected and analyzed from the Firing Range treatment area. All the results were shown to be below the TCLP limit. An *a posteriori* sample size determination was performed to determine if the sample size was sufficient to assess compliance with the TCLP limit. We use the same equation used to calculate sample size, but, in this case, turn the equation around and solve for the *K* factor using the sample mean and standard deviation of the 8 samples. The calculated *K* factor is then compared to the table of factors for estimating the upper confidence limit on the p^{th} percentile from a normal distribution (Table 3). In our case, the percentile of concern is the 99^{th} percentile with a confidence level of 95%. The sample size (n) associated with the largest tabled *K* factor less than the calculated *K* would be the required sample size to demonstrate that the UTL of the population is less than the TCLP limit. If this sample size is less than or equal to 8, we would conclude that the sample size was sufficient.

Sample #		Reported Result	Calculation Value*
FR-A-2	<	0.05	0.025
FR-A-3		0.358	0.358
FR-A-4	<	0.05	0.025
FR-B-1	<	0.05	0.025
FR-B-2	<	0.05	0.025
FR-B-3		0.394	0.394
FR-C-1	<	0.05	0.025
FR-C-2	<	0.05	0.025
UTL			5.00
mean =			0.113
sd =			0.163
calc. K =			30.026
Percentile		**Min. Required N**	
95th			2
99th			**3**
99.9th			3

* Calculation Value is one half of the Detection Limit for non-detects, otherwise, it is the reported result. The calculated K value of 30.026 is greater the tabled value for n=3 (10.553) but less than the tabled value for n=2 (37.094) which indicates that the required sample size would, at a minimum, be equal to 3. Therefore, the *a posteriori* sample size determination indicates that the actual sample size of 8 was sufficient to assess compliance with the TCLP limit.

Table 3

Factors $K_{1-\alpha,p}$ for Estimating an Upper 100 (1 — α)% Confidence Limit on the p[th] Percentile of a Normal Distribution

1 - α = .95	Percentile		
n	**95[th]**	**99[th]**	**99.9[th]**
2	26.260	37.094	49.276
3	7.656	10.553	13.857
4	5.144	7.042	9.214
5	4.210	5.749	7.509
6	3.711	5.065	6.614
7	3.401	4.643	6.064
8	3.188	4.355	5.689
9	3.032	4.144	5.414
10	2.911	3.981	5.204
11	2.815	3.852	5.036
12	2.736	3.747	4.900
13	2.670	3.659	4.787
14	2.614	3.585	4.690
15	2.566	3.520	4.607
16	2.523	3.463	4.534
17	2.486	3.414	4.471
18	2.455	3.370	4.415
19	2.423	3.331	4.364
20	2.396	3.295	4.319
21	2.371	3.262	4.276
22	2.350	3.233	4.238
23	2.329	3.206	4.204
24	2.309	3.181	4.171
25	2.292	3.158	4.143
30	2.220	3.064	4.022
35	2.166	2.994	3.934
40	2.126	2.941	3.866
45	2.092	2.897	3.811
50	2.065	2.863	3.766
60	2.022	2.807	3.695
70	1.990	2.766	3.643
80	1.965	2.733	3.601
90	1.944	2.706	3.567
100	1.927	2.684	3.539
120	1.899	2.649	3.495
145	1.874	2.617	3.455
300	1.800	2.522	3.335
500	1.763	2.475	3.277
¥	1.645	2.326	3.090

3.0 SUMMARY

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The results of the verification of treatment sampling and analysis show that the treated Firing Range soils exceed the requirements of the TCLP test for lead (5.0 mg/l). Further, the *a posteriori* sample size test determined that the sample size (8 samples) was sufficient to assess compliance with the TCLP limit.

Appendix A

Laboratory Reports

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

2463

Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999

Sample ID	: 200357348
Lab ID	: 9907613-01
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead	<	50.0	ug/l	EPA 6010A	MBL	07/23/99	1243	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

Reviewed By

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9907613-01

GENERAL ENGINEERING LABORATORIES

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Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999 Page 1 of 1

Sample ID	: 200357352
Lab ID	: 9907613-02
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead	<	50.0	ug/l	EPA 6010A	MBL	07/23/99	1248	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

Reviewed By

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9907613-02

GENERAL ENGINEERING LABORATORIES

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Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999

Sample ID	: 200357353
Lab ID	: 9907613-03
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead		358	ug/l	EPA 6010A	MBL	07/23/99	1254	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

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GENERAL ENGINEERING LABORATORIES

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Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999

Sample ID	: 200357354
Lab ID	: 9907613-04
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead	<	50.0	ug/l	EPA 6010A	MBL	07/23/99	1300	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

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Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999

Sample ID	: 200357355
Lab ID	: 9907613-05
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead	<	50.0	ug/l	EPA 6010A	MBL	07/23/99	1305	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

E Hanson

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Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999

Sample ID	: 200357356
Lab ID	: 9907613-06
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead	<	50.0	ug/l	EPA 6010A	MBL	07/23/99	1311	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

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Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999

Sample ID	: 200357357
Lab ID	: 9907613-07
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead		394	ug/l	EPA 6010A	MBL	07/23/99	1328	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

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GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

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Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999

Sample ID	: 200357358
Lab ID	: 9907613-08
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead	<	50.0	ug/l	EPA 6010A	MBL	07/23/99	1334	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

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9907613-08

GENERAL ENGINEERING LABORATORIES

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Client: Sevenson Environmental Services,Inc.
9245 Calumet Avenue
Suite 101
Munster, Indiana 46321
Contact: Mr. Steven Sharpe
Project Description: Lead Stabilization Project - Fernauld site

cc: SVES00199 Report Date: July 26, 1999

Sample ID	: 200357359
Lab ID	: 9907613-09
Matrix	: TCLP
Date Collected	: 07/13/99
Date Received	: 07/15/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	Units	Method	Analyst	Date	Time	Batch
Metals Analysis								
Lead	<	50.0	ug/l	EPA 6010A	MBL	07/23/99	1339	153958
The following prep procedures were performed:								
TCLP Prep for Metals				EPA 3005	JJ	07/20/99	1550	153779

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

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9907613-09

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~~WASTE STREAM~~

~~GEL LABS.~~

SEVENSON ENVIRONMENTAL SERV.

100000 19484 9907013/

CSR-99-0791

CHAIN OF CUSTODY RECORD

-5CW23-

PROJECT NO: E598 SITE NAME: FERNALD

SAMPLERS (SIGNATURE):

	SAMPLE NO.	DATE	TIME	COMP	GRAB	MATRIX	SAMPLE LOCATION	SIZE & NO. OF CONTAINERS	TCLP LEAD							PRESERVATIVES	REMARKS
01	FR-A-1	7/13/99	1630		X	SOIL	FIRING RANGE	1 X 500ml	X		200357348					NONE	IMPORTANT
02	FR-A-2										200357352					NONE	
#03	FR-A-3										200357353					NONE	HOLD ALL SAMPLES
#04	FR-A-4										200357354					NONE	FOR 7 (SEVEN)
05	FR-B-1										200357355					NONE	DAYS PRIOR
06	FR-B-2										200357356					NONE	TO BEGINNING
07	FR-B-3										200357357					NONE	ANALYSIS
08	FR-C-1										200357358					NONE	
09	FR-C-2	↓	↓		X	↓	↓	↓	X		200357359					NONE	

24663

000021

RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED BY (SIGNATURE)	RELINQUISHED BY (SIGNATURE)	DATE/TIME	RECEIVED BY (SIGNATURE)
[signature]	7/13/99 1700	Jessie E. Grace	Jessie E Grace	07/14/99 09:00	[signature]
[signature]	7-14-99 1300	[signature] 7/15/99			

SPECIAL INSTRUCTIONS:

TURNAROUND TIME STD. 20713 - A2P1 Firing Range Stabilization Project

LAB USE: REFRIGERATOR # _____ SHELF # _____ GROUP # _____ DUE DATE _____